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Aviation Project Review Note for Wood Group UK Ltd
Mynydd Carn y Cefn Wind Farm

Our Reference: WPAC/025/22

Your Reference: Wood PO 26010543

Author: Commander John Taylor, Royal Navy (Ret)

Radar Propagation Modelling – Dr David Bacon BSc, PhD, FIET, C.Eng.
Additional Propagation Modelling, GIS and Mapping – Sam Taylor BA (Hons) MSc

Wind Power Aviation Consultants Ltd, Company No.: 6811887
e-mail: enquiries@wpac.co.uk Tel.: +44 (0)2380767345 Mob.: +44 (0)7949234440
www.wpac.co.uk

Initial Project Review Feasibility - Briefing Note re Mynydd Carn Y Cefn Wind Farm

Introduction and Scope

- Pennant Walters are planning to develop a wind farm at Mynydd Carn Y Cefn, Blaenau Gwent and are advised by Wood Group UK Ltd who have requested aviation consultancy advice from WPAC Ltd. This note will review the work undertaken so far in relation to aviation, stakeholder consultations and responses and provide advice on further actions required to enable the site to address any aviation objections. It will also assess the effect of the proposed development on aviation operations in order to provide an accurate baseline to inform the EIA. The assessment assumes a development of 8 turbines of up to 180 metres to tip. Radar modelling of all 8 turbines has been undertaken in order to identify any potential radar interference issues. This note will also flag up any issues that in our judgement would create an aviation effect critical to the feasibility of the site. Some initial GIS is also provided to show the location in an aviation context.

- WPAC is currently advising developers and planners on approximately 50 planning applications throughout the UK including 10 in Wales. Since 2008 we have assessed over 3000 wind farm proposals, provided EIA chapters to many planning applications and given expert witness evidence at more than 20 planning inquiries. We have also provided aviation advice to the Welsh Government and negotiated a number of wind farm issues with Cardiff International Airport. Further information is available at www.wpac.co.uk

Documentation Provided

- Location Map
- Turbine Layouts
- NATS Airports TOPA
- MOD Initial Response

Turbine	Location	Turbine	Location
1	SO 19825 04810	5	SO 21060 03615
2	SO 20204 04519	6	SO 19865 03445
3	SO 20425 04190	7	SO 20250 03325
4	SO 20740 03895	8	SO 20315 02895

Table 1 Turbine Locations

Background

- The site is located as shown in Figures 1 to 4. Figures 2 to 4 show the location in an aviation context with Figures 2 and 3 showing the airspace up to 5000ft and Figure 4 up to 19500 ft. The site is approximately 40km to the north of Cardiff Airport and as shown in Figure 2 is 7km to the east of the Brecon (BCN) VOR/DME radio navigation beacon. Figure 4 shows the site is underneath Class A controlled airspace and is at the confluence of two busy airways taking traffic east/west from London to the Atlantic and Ireland and north/south taking traffic from Manchester/Scotland to Spain and France.

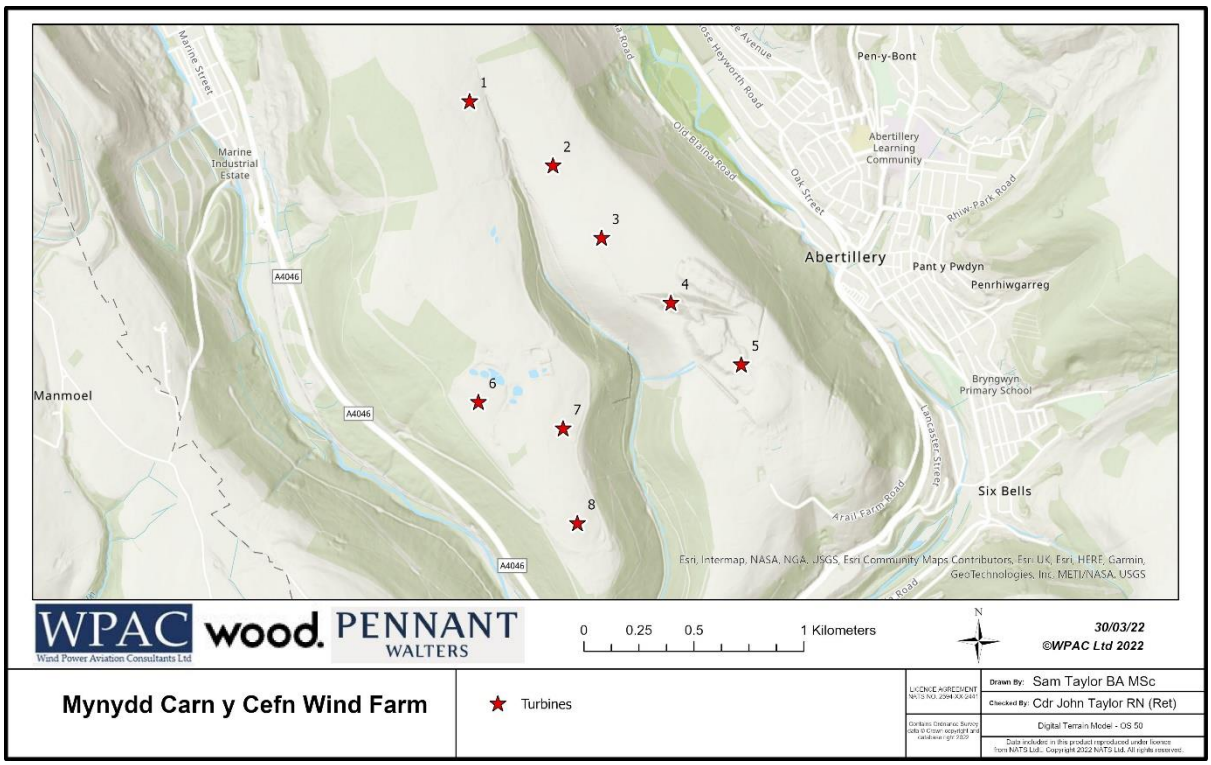

Figure 1

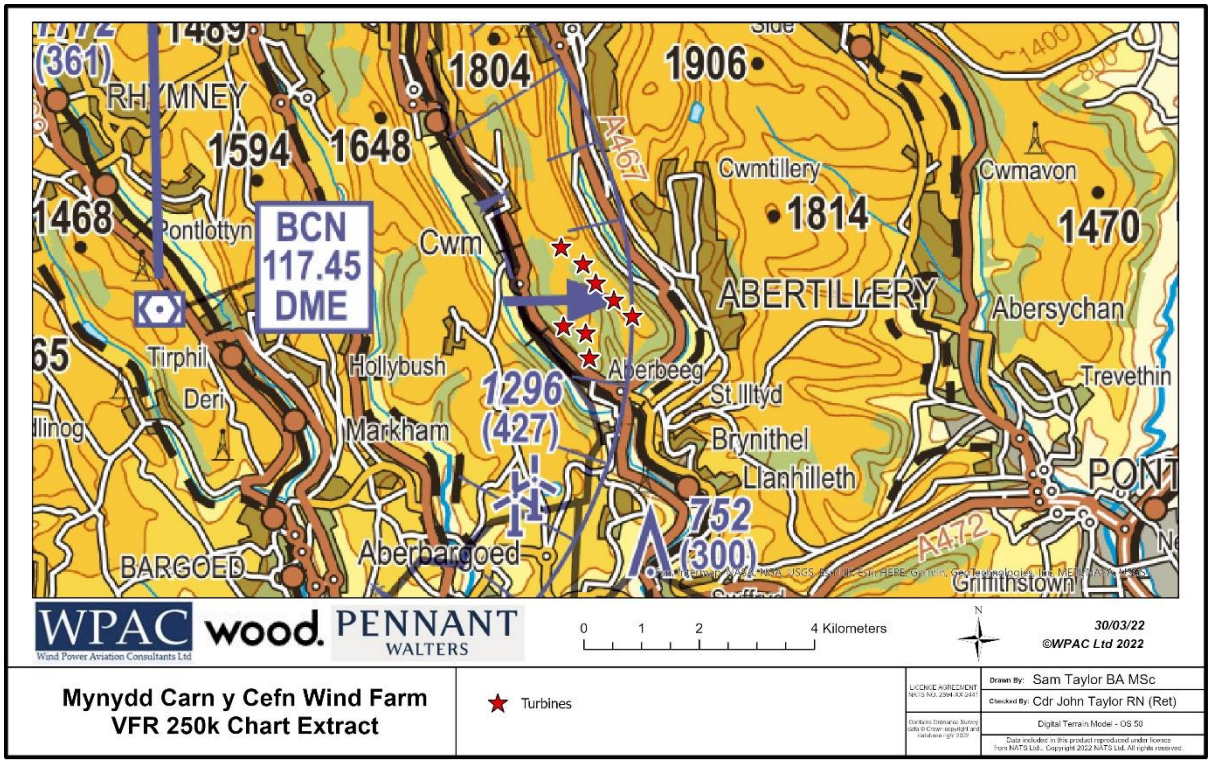

Figure 2

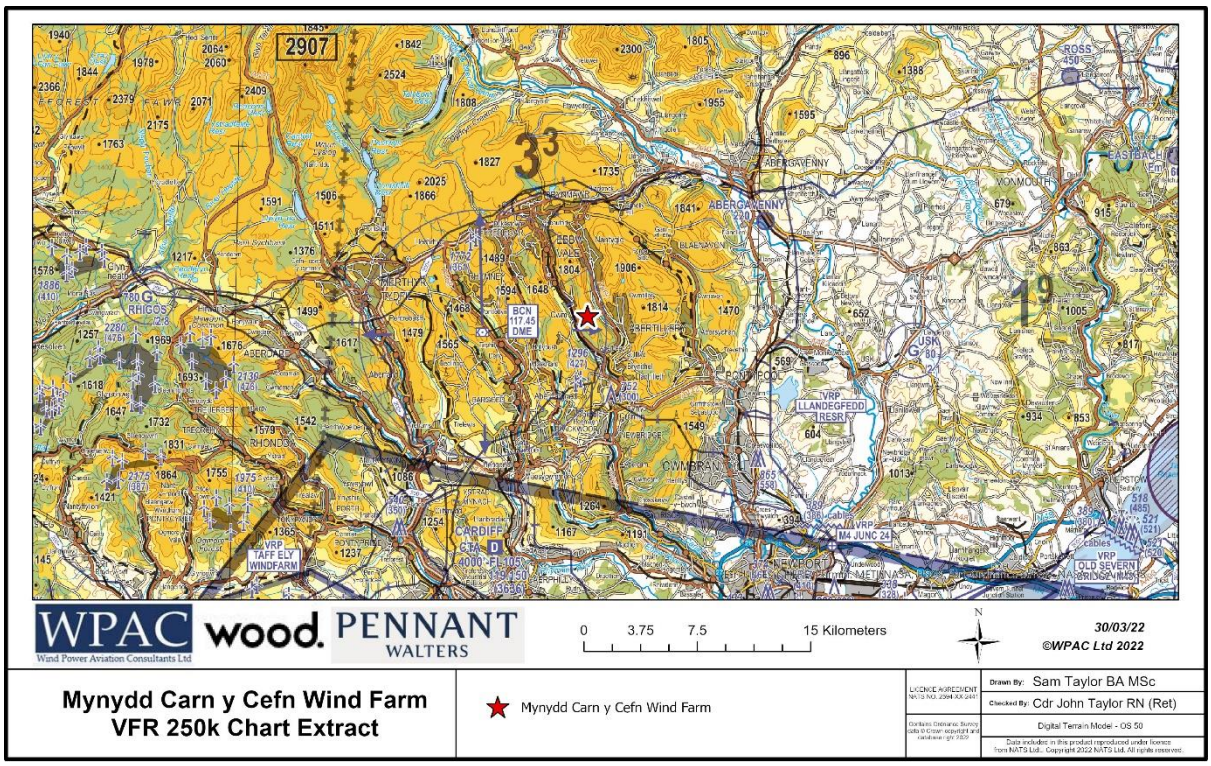

Figure 3

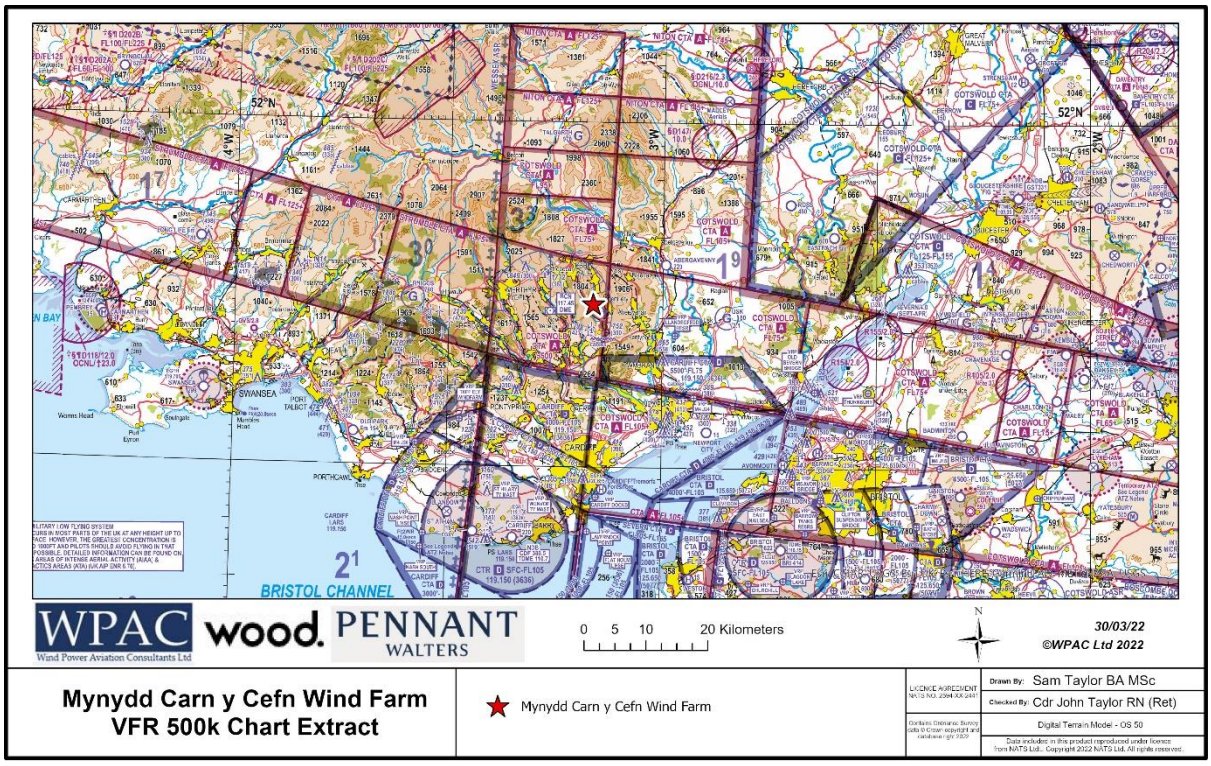

Figure 4

Aviation Issues

- **MOD** – radar modelling has been undertaken which shows that the turbines will not be visible to any MOD ATC radars. The closest military ATC radars are at RAF Brize Norton and RNAS Yeovilton. Radar line of sight is in excess of 500 metres AGL from both radars over the turbine locations. There is an additional MOD ATC radar located at Hartland Point, used at RNAS Yeovilton for training of fighter control students, with aircraft operating over the Bristol Channel and South Wales. In this case radar line of sight is in excess of 370 metres AGL. These figures confirm the MOD position as expressed in their DIO10053728 dated 17th Jan 2022 where they do not mention MOD ATC radars as an issue of concern.

- **Air Defence Radar** – the closest AD radar is at Portreath in North Cornwall. Radar modelling has been undertaken which shows that the turbines will be screened by at least 500 metres by terrain and there will be no MOD AD radar objection.

Low Flying –

- The Mynydd Carn Y Cefn site is located well outside of any MOD Tactical Training Areas and examination of detailed MOD low flying charts (not available to the general public) show that the site is not within a choke point or flow arrow within the low flying system. It is also the case that it is located within a 'Green' area as shown in the MOD wind farm low flying chart as shown in the extract at Figure 5.

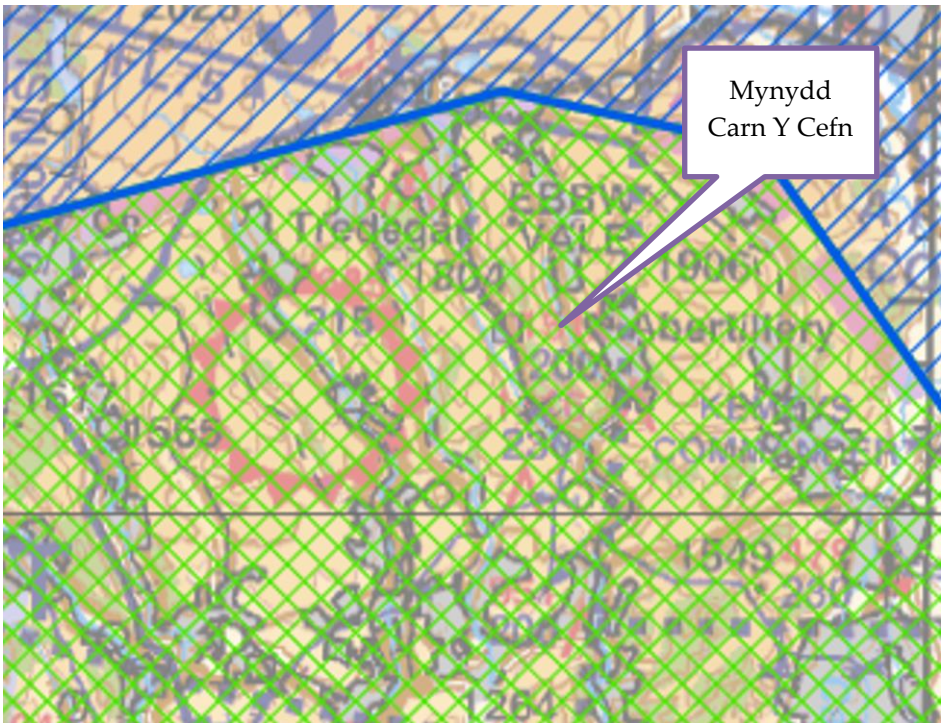

Figure 5 Low Flying Chart Extract

- A Green Area is defined as: '*Areas with no military low flying concerns*'. This rather contradicts the MOD response which states: '*I am writing to inform you that the MOD may have concerns about the proposal.*' Their concern is based on their standard response to any wind farm application in the UK. It is the case that in a green area low flying does not take place due to other constraints such as population density, airspace or other factors, however, their 'concern' is just a routine and non-specific comment designed to ensure that the turbines are fitted with Infra-Red obstruction lights which are not visible to the naked eye.

- **Met Office Radars** – The MOD response also mentions Met Office radars. Again this is a standard response to any application. In this case the closest Met Office radars are at Crugg Y Goryllwynn and Clee Hill. The Met Office will only become concerned where turbines are likely to be in line of sight of their radars within 20km. Both of these radars are well beyond that distance. Crug Y is over 94km to the west.

Civil Radar Equipped Airports

- **Cardiff Airport** – Cardiff is a busy airport 40km to the south. Radar modelling has been undertaken with the results shown in Table 2.

Turbine	Radar Line of Sight (metres AGL)	Turbine	Radar Line of Sight (metres AGL)
1	0	5	86.9
2	22.2	6	48
3	18.5	7	91.3
4	76.6	8	130.1

Table 2 Radar Line of Sight for Cardiff Airport Radar

- These results confirm that every turbine will be exposed to the radar to a greater or lesser extent and will be likely to generate 'clutter' (unwanted radar returns) and other effects such as track obscuration over the site. It is noted that you instructed NATS to undertake a Technical and Operational Assessment (TOPA). The situation at Cardiff is slightly confusing in as much as NATS Services PLC (NSP) provide ATC services to Cardiff Airport under contract. The airport is owned and operated by the Welsh Government and Cardiff Airport is the CAA license holder and responsible for the safe operation of the airport. You instructed a TOPA, unfortunately you only asked for an airfield TOPA and not a combined one, I will return to this issue later in the report. However, NATS at Cardiff confirmed that the turbines will be visible to the radar and will cause a technical impact on the performance of the radar. They then conducted a 'so what' test to determine if the technical effect would affect their delivery of ATC services. Unfortunately they concluded that it would for what are coherent ATC service provision reasons. In this case, at a distance of over 40km and clear of their control zone it could be argued that the effect would be manageable, it is certainly marginal. It might be possible to argue that NATS are wrong to object in this location, however, I do not recommend it. They have justified their position in ATC service provision terms

and Cardiff have in the past shown themselves willing to accept the impact of a number of wind farms on their radar, so where they do maintain an objection it should be taken seriously. It is also the case that if this site went to appeal, a planning inspector would be almost certain to support their objection on flight safety grounds, marginal or not.

- The issue then becomes one of mitigation. The radar at Cardiff is a Thales Star 2000 which has no wind farm mitigation capabilities, however, a number of other wind farm developers are in discussion with Cardiff about funding the provision of a Terma Scanter 4002 radar which is wind farm capable. This type of radar has already been installed at a number of locations in the UK including Glasgow (also a NATS ATC service contract), Edinburgh, Newcastle and Liverpool. The radar can be located at Cardiff Airport and integrated into the ATC radar display system. It would therefore be sensible to approach Cardiff Airport in order to agree a planning condition contingent upon the provision of a Terma radar. Another developer is already likely to fund the radar and then recover costs from other developers who wish to make use of it. It will be important to gain Cardiff and NATS agreement for this approach but it should be considered as non-contentious and it is certainly not a risk from a technical perspective as this type of radar is already installed and working elsewhere in the UK as a wind farm mitigation system. It will require an approach to both NATS as the service provider and Cardiff Airport as the license holder.

- **To conclude**: the turbines **will be visible to the Cardiff radar**, they are likely to maintain an objection and mitigation is likely to be available. The proposed development is well within the coverage of the Terma radar. The only issue will become one of affordability. The action required is to set up a meeting with Cardiff/NATS in order to enable a condition to be agreed.

- **Bristol Airport** – the site is 50km from Bristol Airport. It is noted that the NATS TOPA concludes that the turbines will be visible to the radar, but in this case there is no operational effect. I can confirm that the turbines would all visible to the radar but it is fortunate that the operational conclusion is that the effect can be tolerated.

- **Light Aircraft Landing Strips, Gliding and Microlight Sites –** none marked on charts or known within the defined consultation distances. The closest is at Abergavenny, over 12km to the north-east and well beyond the 3km consultation distance.

- **NERL** – this is where things can get slightly confusing – NERL is NATS En Route Ltd, a separate organisation to NSP although they are clearly connected. NERL provides ATC services mainly in the '*en route*' environment using a network of radars, radio stations and navigation aids. The radars are networked together and utilised by controllers at the London Centre at Swanwick in Hampshire. There are two radars that cover this area at low level, Clee Hill in Shropshire and Burrington in Devon; radar modelling has been undertaken for both radars. The results show that radar line of sight from Burrington is above 500 metres AGL and the turbines will be screened by terrain. The results for Clee Hill are marginal as shown in Table 3 overleaf. Assuming a turbine tip height of 180 metres, Turbine 3 will be visible to the radar and this may generate a NERL objection given the location at the confluence of two airways. It would be prudent to consult with NERL in order to find out their position in relation to this location, it would have been better to have instructed a 'Combined' TOPA which includes all of the NERL surveillance, navigation and

communication systems rather than a airfield one, as any effect on Clee Hill radar would then have been captured and addressed. It is also surprising that NERL have not yet responded to the application. My recommendation is to approach this head on in case it comes back to become an issue late in the application process. It may be possible if they object, to agree a 'single cell blank' if they agree that only one turbine is visible and agree a planning condition to protect the radar. The alternate approach is to move T3 to a location that is screened by terrain.

Turbine	Radar Line of Sight (metres AGL)	Turbine	Radar Line of Sight (metres AGL)
1	228.8	5	204
2	209	6	245.4
3	170.8	7	217.5
4	186.6	8	264.5

Table 3 Clee Hill radar results

- Brecon (BCN) VOR/DME – the radio navigation aid at BCN is located approximately 7km from the wind farm. This is well beyond the technical safeguarding footprint defined in CAP670 (Technical Safeguarding of Aeronautical Radio Stations Part B Section 4 GEN02) which defines the safeguarded area for DME as a 500 metre radius with a 2% slope, and for VOR at GEN01.18 which safeguards a circle at ground level of 230m radius with a further 2% slope out to 900m. The turbines at 7km are therefore well outside the safeguarded footprint. However, a NATS En Route TOPA will confirm their position in relation this this as well as radar.

Aviation Lighting

- With turbines in excess of 150 metres to tip there is a requirement to illuminate them with medium intensity red obstruction lights on the nacelle. There is also the requirement to provide IR lighting for the MOD. WPAC design lighting layouts to minimise the number of lit turbines and gain MOD and CAA approval. There is also a requirement for mid mast lights, halfway up the tower. These are low intensity red lights but are very poorly designed and often have a greater visual impact than the hub lights. Where feasible WPAC can negotiate a waiver to this requirement with the CAA. Finally we provide a full lighting report which includes calculations of the effect of the lights on designated viewpoints which is used to inform the LVIA. We are currently working with Wood on a number of sites in Scotland where this work is being undertaken.

Conclusion

- **MOD ATC Radar –** no radars affected

- **MOD Low Flying –** the site is in a Green area and an MOD low flying objection is extremely unlikely

- **MOD Air Defence Radar –** none affected

- **Met Office Radar –** none affected

- **Light Aircraft Landing Strips –** none to affect

- **Civil Airports –** the turbines will all be visible to Cardiff Airport radar and technical mitigation will be required. The turbines will also be visible to Bristol Airport radar but NATS have decided that the effect is manageable.

- **NERL –** one turbine may be visible to the Clee Hill radar. NERL may object due to the location and mitigation may be required.

Next Actions

- In my judgement this is a good site for 180 metre turbines, but it will be necessary to mitigate the effect on Cardiff Airport Radar. Taking into account their opinion expressed in the TOPA it is important to open dialogue with a view to agreeing mitigation and a planning condition.

- It is essential to consult with NERL to ascertain their position in relation to Clee Hill radar and the BCN VOR/DME. If they decide to object in relation to the radar it will be necessary to negotiate a mitigation and planning condition or relocate the offending turbine.

- Lighting – aviation lighting will be required and a lighting design and impact assessment undertaken to both minimise the visual effect and to inform the LVIA.

Cdr John Taylor RN (Ret)
Managing Director
Wind Power Aviation Consultants Ltd
www.wpac.co.uk

Prepared by:
NATS Safeguarding Office

Technical and Operational Assessment (TOPA)

For Mynydd Carn y Cefn Wind Farm Development

NATS ref: SG32844

Issue 1

Contents

Publication History

Issue	Month/Year	Change Requests and summary
1	March 2022	Airport Pre-planning Assessment

Document Use

External use: Yes

Referenced Documents

1. Background

1.1. Airport Consultation

NATS provides air traffic services at most of the UK's major airports. Included in the service that NATS provides to these airports is technical and operational safeguarding.

Whilst the airport owner or operator remains the statutory planning consultee, NATS carries out the assessment and provides technical advice to the airport. This includes making a recommendation on whether to object or not to a planned development.

The Airport Assessment section of this document details any advice NATS would provide to relevant airports.

Please note that where airport consultation is undertaken, any assessment and any statements made refer exclusively to the impact of wind turbines upon the Air Traffic Control infrastructure and only to airports where NATS provides safeguarding services namely Aberdeen, Cardiff, Glasgow, Heathrow, Stansted, Manchester and Southampton.

An airport operator may object on other aviation grounds such as obstacle clearance despite no impact being anticipated on its ATC infrastructure. If in doubt, the airport operator should be consulted for advice.

2. Scope

This report provides NATS En-Route plc's view on the proposed application in respect of the impact upon its own operations and in respect of the application details contained within this report.

Where an impact is also anticipated on users of a shared asset (e.g. a NATS RADAR used by airports or other customers), additional relevant information may be included for information only. While an endeavour is made to give an insight in respect of any impact on other aviation stakeholders, it should be noted that this is outside of NATS' statutory obligations and that any engagement in respect of planning objections or mitigation should be had with the relevant stakeholder, although NATS as the asset owner may assist where possible.

3. Application Details

Steven Fitzpatrick, Wood PLC submitted a request for a NATS technical and operational assessment (TOPA) for the development at Mynydd Carn y Cefn Wind Farm. It will comprise turbines as detailed in Table 1 and contained within an area as shown in the diagrams contained in Appendix B.

Turbine	Lat	Long	East	North	Hub (m)	Tip (m)
1	51.7362	-3.1624	319825	204810	105	180
2	51.7337	-3.1569	320204	204519	105	180
3	51.7308	-3.1536	320425	204190	105	180
4	51.7281	-3.1490	320740	203895	105	180
5	51.7257	-3.1443	321060	203615	105	180
6	51.7240	-3.1616	319865	203445	105	180
7	51.7230	-3.1560	320250	203325	105	180
8	51.7191	-3.1549	320315	202895	105	180

Table 1 – Turbine Details

4. Assessments Required

The proposed development falls within the assessment area of the following systems:

Airports Surv	Lat	Long	nm	km	Az (deg)	Type
Cardiff	51.39390	-3.35260	20.9	38.7	20.2	PSR
Bristol	51.37980	-2.71770	26.1	48.4	322.1	PSR
Airports Nav	**Lat**	**Long**	**nm**	**km**	**Az (deg)**	**Type**
None						
Airports AGA	**Lat**	**Long**	**nm**	**km**	**Az (deg)**	**Type**
None						

Table 2 – Impacted Infrastructure

4.1. Cardiff Assessment

4.1.1. Technical Assessment

Using the theory as described in Appendix A and development specific propagation profile it has been determined that the terrain screening available will not adequately attenuate the signal, and therefore this development is likely to cause false primary plots to be generated. A reduction in the RADAR's probability of detection, for real aircraft, is also anticipated.

4.1.2. Operational Assessment

The proposed wind farm is sited in an area that is very popular with VFR traffic often on navigational exercises between west Wales and England as well as local traffic from Cardiff and St. Athan who will be on our LARS frequency.

In addition to the issues described above it is also sited beneath airway Q63. A strong primary radar return in this location could lead to ATCOs believing there to be an infringing aircraft and therefore taking avoiding action, or become too familiar with the returns and potentially not detect an infringing aircraft believing the return to be the wind turbines and therefore not issuing avoiding action when they should have done.

4.2. Bristol Assessment

4.2.1. Technical Assessment

Using the theory as described in Appendix A and development specific propagation profile it has been determined that the terrain screening available will not adequately attenuate the signal, and therefore this development is likely to cause false primary plots to be generated. A reduction in the RADAR's probability of detection, for real aircraft, is also anticipated.

4.2.2. Operational Assessment

No operational impact expected.

5. Conclusions

5.1. Airport Consultation

The proposed development has been examined by technical and operational safeguarding teams. A technical impact is anticipated, this has been deemed to be unacceptable due to the impact on the operation at Cardiff Airport.

Appendix A – Background RADAR Theory

Primary RADAR False Plots

When RADAR transmits a pulse of energy with a power of P_t the power density, P, at a range of r is given by the equation:

$$P = \frac{G_t P_t}{4\pi r^2}$$

Where G_t is the gain of the RADAR's antenna in the direction in question.

If an object at this point in space has a RADAR cross section of σ, this can be treated as if the object re-radiates the pulse with a gain of σ and therefore the power density of the reflected signal at the RADAR is given by the equation:

$$P_a = \frac{\sigma P}{4\pi r^2} = \frac{\sigma G_t P_t}{(4\pi)^2 r^4}$$

The RADAR's ability to collect this power and feed it to its receiver is a function of its antenna's effective area, A_e, and is given by the equation:

$$P_r = P_a A_e = \frac{P_a G_r \lambda^2}{4\pi} = \frac{\sigma G_t G_r \lambda^2 P_t}{(4\pi)^3 r^4}$$

Where G_t is the RADAR antenna's receive gain in the direction of the object and λ is the RADAR's wavelength.

In a real world environment this equation must be augmented to include losses due to a variety of factors both internal to the RADAR system as well as external losses due to terrain and atmospheric absorption.

For simplicity these losses are generally combined in a single variable L

$$P_r = \frac{\sigma G_t G_r \lambda^2 P_t}{(4\pi)^3 r^4 L}$$

Secondary RADAR Reflections

When modelling the impact on SSR the probability that an indirect signal reflected from a wind turbine has the signal strength to be confused for a real interrogation or reply can determined from a similar equation:

$$P_r = \frac{\sigma G_t G_r \lambda^2 P_t}{(4\pi)^3 r_t^2 r_r^2 L}$$

Where r_t and r_r are the range from RADAR-to-turbine and turbine-to-aircraft respectively. This equation can be rearranged to give the radius from the turbine within which an aircraft must be for reflections to become a problem.

$$r_r = \sqrt{\frac{\lambda^2}{(4\pi)^3}} \sqrt{\frac{\sigma G_t G_r P_t}{r_t^2 P_r L}}$$

Shadowing

When turbines lie directly between a RADAR and an aircraft not only do they have the potential to absorb or deflect, enough power such that the signal is of insufficient level to be detected on arrival.

It is also possible that azimuth determination, whether this done via sliding window or monopulse, can be distorted giving rise to inaccurate position reporting.

Terrain and Propagation Modelling

All terrain and propagation modelling is carried out by a software tool called ICS Telecom (version 11.1.7). All calculations of propagation losses are carried out with ICS Telecom configured to use the ITU-R 526 propagation model.

Appendix B – Diagrams

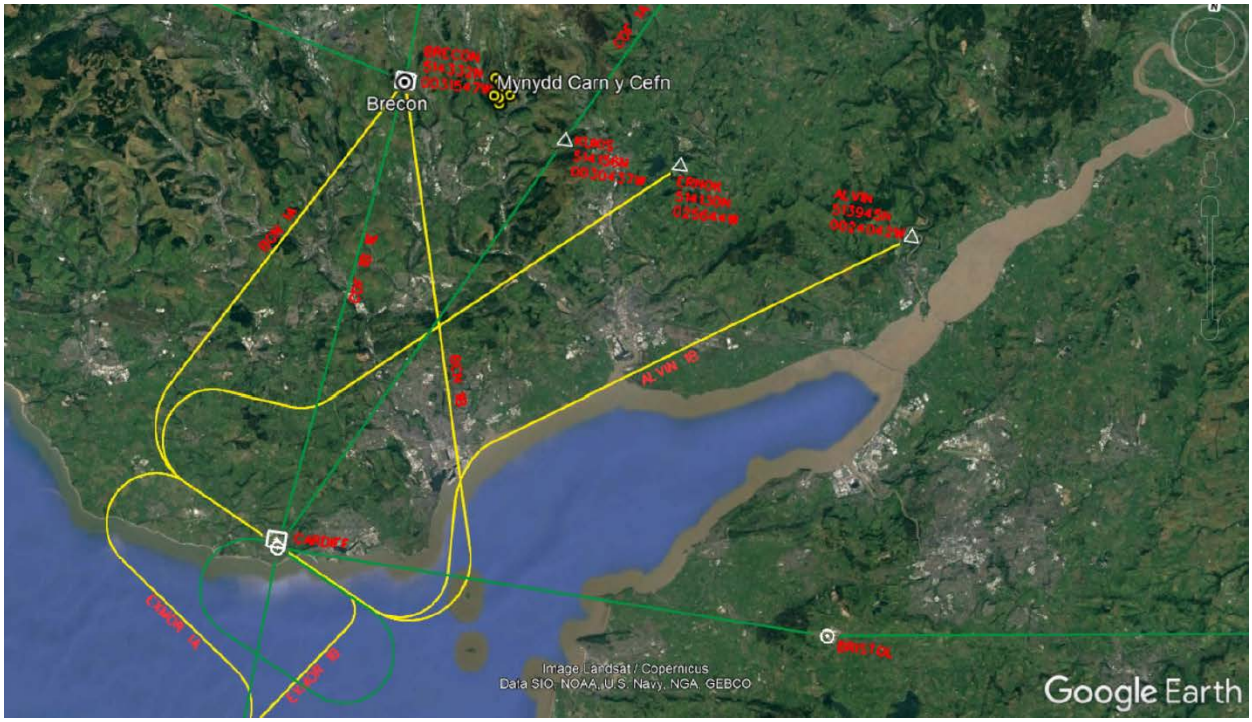

Figure 1: Proposed development location shown on an airways chart – Cardiff

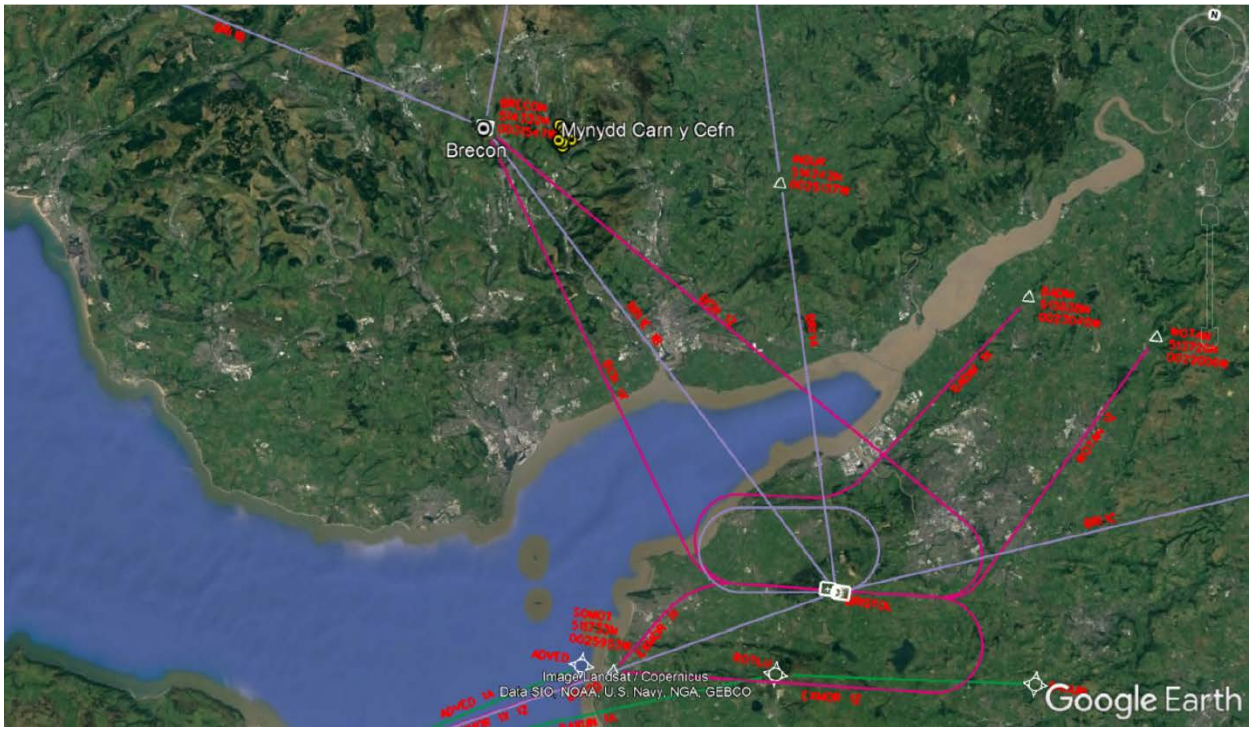

Figure 2: Proposed development location shown on an airways chart - Bristol